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Psychosocial Factors Involved in Opting Engineering as Career: Qualitative Analysis

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Research has shown a decreased readiness and motivation of students to pursue engineering fields despite of increased demand for trained workforce for economic growth and development. The present study was undertaken to explore the factors influencing students at their high school level to pursue engineering as a career or not. The objective was to explore students' perception of psychosocial factors involved in their academic satisfaction, and persistence intention to pursue career in engineering while studying at pre-engineering level. Twelve focus group discussions with students from BS engineering (7) and non-engineering (5) educational fields from different public universities of Islamabad were conducted. Thematic analysis was done to analyze the data. The major themes emerged were academic and vocational interest, motivation, social support, personality characteristics, barriers etc. The result suggests the importance of these factors in pursuing career in engineering where there must be interest of the students in the field opted; they must be motivated to learn in context of social support extended by friends, family and teachers. Beside this, there are some barriers from different sources like academia, parents, teachers, etc. that restrain the students from perusing and getting into engineering field. There were some major group differences among engineering and non-engineering students regarding perception of different themes. Conclusively, both groups differed in their interest, motivation, support, and barriers although students from non-engineering academic fields had high grades and potential to continue engineering, but barriers were stronger in some situations or interest and motivational factors were lacking that inhibited them to pursue career in engineering.

Keywords: Psychosocial factors, qualitative, academic satisfaction, burnout, persistence intension, engineering, non-engineering.

The modern world and the lives of an enormously growing population and technology are dependent on the field of engineering and technology for productivity, to feed people effectively, to save lives, to increase efficiency, and promote technology. Although there are a number of engineering universities in Pakistan, but it is observed that trained engineers produced often lack the practical approach needed to solve real industrial problems for which the deficiencies and barriers can be traced back to the beginning of the education in the area that is in pre-engineering at high school level when students make major decision of what to opt for in their career (McMullin, & Reeve, 2014; Mosley, Liu, Hargrove, & Doswell, 2010). Student's lack of interest in the fields of engineering and technology has rendered unanswerable question marks for the educationists, companies, and policy makers about underlying prosocial factors involved in lack of interest in students to opt engineering or deteriorated practical implications which need to be addressed by having evidence based approach.

Pakistan is facing plethora of challenges including poverty, corruption, high rates of illiteracy, overpopulation, terrorism, gender inequalities both in education and the workforce (United Nations Development Program, [UNDP] 2013). World over, countries like to improve their population's proficiency in scientific and mathematical skills to enable them to participate and compete more effectively within a competitive global economy.

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In Pakistan's context too there is a clear need to make advancements in Science, Technology, Engineering, and Mathematics (STEM), given that the country lags behind in the number of proficient scientists, mathematicians, and engineers compared to industrialized nations to meet growing need of the population to make available basic necessities of life.

Even in the US there is a gap between the nation's growing need for scientists, engineers, and other technically skilled workers, and actual number available (Jackson, 2004). Opting engineering as career has decreased in the recent years. High attrition rate than persistence is a matter of serious consideration, and therefore the factors leading to this need to be identified (Baillie & Fitzgerald, 2000).

There is an emerging concern in educational circles in industrialized nations about the low rates of progress in higher education related to science and a lesser participation of women in these fields (e.g., Bøe, Henriksen, Lyons, & Schreiner, 2011; Hazari, Sonnert, Sadler, & Shanahan, 2010).

A study was conducted to explore the underlying causes behind low achievement in mathematics by covering the perception of teachers, parents, and students in district Faisalabad, Pakistan which revealed strictness while teaching mathematics as the major cause of low achievement in mathematics by students. Besides this, lack of practice, and lack of attention were reported by teachers and parents, respectively (Ali & Jameel, 2016).

In Pakistan the field of STEM is still neglected. A recent study explored the need of integration of various concepts of STEM fields in the context of Pakistan through practical and theoretical consideration. Research employed inductive approach to analyze multiple data sources of interviews, STEM perception responses, reflective learning team conversations, pre-post surveys and artifacts produced in online teacher professional development in STEM fields. Designed based directions were applied as an implication of the study findings. The research further suggested a school-wide online professional development training for interdisciplinary collaboration through support for learner-centered practices (Anwar, 2017).

Engineering fields or major science fields are lacking behind not only because of the negligence of government, existing policies and educational level, but also due to the loss of interest of students in the fields of engineering. Interest is viewed as the predictor of both career orientation and achievement/ performance and students most likely pursue the fields they are interested in. Researches have linked interest to achievement, pursuance of , and degree completion (less attrition rate) and serves as a predictor for later career choices (Goulet & Singh, 2002; Renniger & Hidi, 2016; Tai Liu, Maltese, & Fan, 2006; Wigfield & Cambria, 2010). Most of researches considered self-efficacy as a predictor of interest (Fouad & Smith, 1996), while other researchers suggest that interest encourages the task related efficacy development among students of science subjects (Nauta, Kahn, Angell, & Cantarelli, 2002; Tracey & Darcy, 2002).

Education is considered as a key for finding and reaching future career goals and people tend to have expectations from their career choices. This expectation as an outcome is the expected consequence of a behavior, like in studying engineering. Career expectations measure youth's perception of certain careers based on their perceived intrinsic or extrinsic values. Researches (such as Fouad & Smith, 1996; Holmegaard, Madsen, & Ulriksen, 2014) confirmed the importance of expectancy in predicting career persistence intention. Moreover,

Social Cognitive Career Theory (Lent, Brown, & Hackett, 2002) has declared it as a mediator of career and academic interest.

Although, there are a vast number of researches on STEM education, career aspirations and factors affecting STEM fields, but the factors affecting the decision making of students to choose engineering is still an emerging topic and an important research domain (Banning, & Folkestad, 2012). More than three out of four high school students who rest in the top mathematics quartile do not pursue an engineering major in their careers. In 2011, considering the decline in the interest of the students, educators and experts were involved to work on the interest, and attitude towards engineering among young students to increase proficiency, interest and positive attitude of the students towards engineering (Carnevale, Smith, & Melton, 2011).

Several studies have been conducted to find out the factors influencing the choice of major fields (DeMarie & Aloise-Young, 2003; Kuechler, McLeod, & Simkin, 2009; Sagiv & Schwartz, 2004; Tan & Laswad, 2009). Research (such as Beggs, Bantham, & Taylor, 2008) identified that career decision making is a major decision in a students' life and wrong decisions has been one of the major life-long regrets. Therefore, a qualitative study was done for undergraduates to identify the basic psychological processes for selecting their majors. Malgwi, Howe, and Bunaby (2005) surveyed undergraduate students concerning their choice of major fields and described that subject interest was the most important factor regardless of gender. The results of the girls indicated that aptitude was a major factor while deciding careers and boys relied more on the potential for an advanced career and job opportunities in the field (referring to the outcome expectancy). Both genders identified interest as the key factor for a field choice (Kuechler, McLeod, & Simkin, 2009).

Interest development is referred to as a process occurring within the individuals but can be influenced by the social mechanisms which include messages from other people, comments, and compliments, (Jackson, Leal, Zambrano, & Thoman, 2019). Interest is observed to be a critical component for persisting in science fields (Renninger & Bachrach, 2015). The development of interest is dependent on individual characteristics (for example personality traits) within a socio-cultural context (e.g., Bergin, 2016; Hulleman, Kosovich, Barron, & Daniel, 2017; Hulleman, Thoman, Dicke, & Harackiewicz, 2017; Master, Cheryan, Moscatelli, & Meltzoff, 2017; Renninger, & Hidi, 2016). As interest develops, a separate but interrelated process of identity development can occur (Krapp, 2007; Renninger, 2009). With respect to educational interests, talking with others about emerging interests is an important social process for negotiating whether that new interest will be recognized and accepted as reality by others (Sansone & Thoman, 2005; Thoman, Smith, & Silvia, 2011).

Other major sources that influence one's interest are social recognition and advice that they receive from others such as parents, peers, and teachers. It is important that others can provide a student with experiences, whether intentional or not, that can influence their interest and engagement fields (Eccles, & Roeser, 2009; Hulleman, Kosovich, Barron, & Daniel, 2017). A past research found that children whose parents talked to them more often about the value of science subsequently enrolled in a greater number of STEM-based courses in high school (Harackiewicz, Rozek, Hulleman, & Hyde, 2012).

A feeling that others respect and understand an individual's interests can help him/her to sustain or expand their personal interests (Renninger & Riley, 2013). It is more important to note that even well-developed interests can become diminished without the support of

others (Renninger & Hidi, 2016; Renninger & Riley, 2013). Social recognition can influence interest through verification. According to self-verification theory (Swann 2011), individuals seek out information to support current perceptions of them.

For students who take sciences as a major and even those in scientific careers recognize themselves as *science persons* and others also recognize them similarly and this is an important part of establishing a scientific identity (Carlone & Johnson, 2007). Family members and friends play a huge role in students' choices throughout their development (e.g. Eccles, 2009) and have been shown to influence STEM related class choices (Harackiewicz, Rozek, Hulleman, & Hyde, 2012).

Beside educational reforms, regarding implementation of the courses and curriculum, the gap is still wide and challenging in the educational and practical implication of the scientific fields. Nathan, Atwood, Prevost, Phelps, and Tran (2011) pointed out that students from high Socio-Economic Status (SES) were favored to study STEM fields by teachers who reported that their instructions were influenced by the student's interest, family background, and prior academic achievement; while, counselors played their role in motivating students for pursuing studies in STEM fields.

Research identified that the number of engineering graduates are declining day by day from the past two decades and this has become the major concern for U.S as the physical sciences and engineering are at risk (Ohland et al, 2008).

The attrition rate of the students in pre-engineering at different levels is yet very high which may be because of different factors like student's interest, motivation, self-efficacy, and attitude, etc. which needs to be assessed for better implementation of possible solutions (Baillie & Fitzgerald, 2000). Asking students about the factors that influence their choices is important as they are contributors of their academic success and failure. The need to conduct the present study is therefore important as students will be asked about the psychosocial factors involved in opting engineering as a profession.

The most important decision of a students' life is not made based on their abilities or skills but is influenced due to many psychosocial factors. The objective of the present study is to identify the psychosocial factors, perceived by student that inhibited or facilitated them to pursue their careers in engineering field.

Social cognitive career theory (SCCT; Lent, Brown, & Hackett, 2002; Lent, 2005) is anchored in Bandura's self-efficacy theory (Bandura & Adams, 1977), which postulated a mutually influencing relationship between people and the environment. SCCT offers three segmental, yet interlocking process models of career development seeking to explain (a) the development of academic and vocational interest, (b) how individuals make educational and career choices, and (c) educational and career performance and stability.

The social cognitive career theory provided the foundation for the present research due to its immense contribution in explaining mechanisms influencing both career orientation and academic satisfaction. It assesses the interplay between interest and satisfaction in predicting student's persistence in engineering (Lent & Brown, 2006; Nugent, et al., 2015) as well as the interplay between cognitive, behavioral, contextual, and personality factors within the process of educational and vocational adjustment (Lent, 2005). This study focused on exploring whether the factors identified by the theorist are perceived by the students or not

and whether these are the important factors, or some other factors are responsible for pursuing the field of engineering. It helps to explain the factors responsible for educational and occupational satisfaction and other aspects of positive adjustment to school and work contexts. There may be many important dimensions that may help us better understand the reason why youth are not pursuing STEM fields.

Research suggest that outcome expectations are important factors in the development of student's interests in future careers (Fouad et al., 2006). Majority of past researches (Betz, 2007; Gainor, 2006; Ferry, Fouad, & Smith, 2000; Lent & Brown, 2006; Tokar, Thompson, Plaufcan, & Williams, 2007) studied the career influencing factors of STEM students quantitatively by assessing them on different factors considering self-efficacy as the primary construct, and limited the data and response of the students to forced choices and hardly studied the actual perceptions and experiences of students and this is the focus of the present study, gaining data qualitatively from engineering and non-engineering students to compare the perceptions of both groups of students in their interest, motivation, and aptitude for engineering as a career.

Multicultural evidences of the theory are available in college and university students (e.g., Creed, Patton, & Prideaux 2007; Dutta, et al., 2015; Kong, Ding, & Zhao, 2015; Menéndez, Calvo & Caro, 2016), so now these will be explored qualitatively in Pakistani context. Hence, the objectives of the current study are:

- To explore students' perception of psychosocial factors involved in academic satisfaction, and persistence intention to pursue a career in engineering while studying at pre-engineering level.
- To compare the psychosocial factors involved in academic satisfaction, and persistence intention to pursue a career in engineering at pre-engineering level among students who pursued engineering and did not pursue engineering later.

Method

Research Design

The current study is Qualitative in nature in which data was collected through Focus Group Discussion (FGD's) and was analyzed through thematic analysis.

Participants

Seven Focus Group Discussions (FGDs) were conducted with students of bachelor's degree program belonging to first semester from any engineering department of different universities of Islamabad. Each FGD consisted of 6-8 students, having ages from 19 to 23 years. From the total of 44 participants 35 students were male and 9 were female. Similarly, five FGD's were conducted with students of bachelor's degree program belonging to first semester from non-engineering departments. Each FGD consisted of 6 students, having ages from 19-21 years. From the total of 53 participants 30 students were male and 7 were female. The participants were from different public sector universities of Islamabad (National University of Modern Languages, COMSATS, Quaid-i-Azam University, & National University of Science & Technology).

Focus Group Interview Guide

A focus group interview guide was prepared for data acquisition. Questions were generated in the light of existing literature. In the focus group guide, questions related to personality, interest, decision making, aptitude, attitude, achievement, social support, motivation, self-efficacy, values, satisfaction, burnout, and barriers with reference to opting a career in engineering were asked.

It included 28 total and 41 probing questions formulated in what, why, and how format to make respondent respond in detail. For example, about personality the question asked was, what are the factors that lead students towards high/low academic achievement? "What should be the personality trait of a person who wants to pursue engineering?" What is the most difficult decision of your life in your educational career?". The probing question for this main question was, "Why do you believe it was a difficult decision? Etc. Focus group guide was updated after each FGD. Same guide was used for both engineering and non-engineering students.

Procedure

Ethical codes given by American Counseling Association approved by ACA Governing Counseling (2014) for psychological research with career aspirations and career studies were followed in the current research. Moreover, the study was approved by Advanced Studies Research Board. Permission from the concerned authorities was sought. Total Twelve FGD's were conducted to get first-hand knowledge on the psychosocial factors for students opting or not opting engineering as career and related facilitators and barriers that they faced during high school to secure admission in engineering at university.

Students were approached from different universities of Islamabad through convenient sampling technique. The real purpose of the study was introduced to the participants and confidentiality was ensured and consent was taken from each participant. Each session started with a broader question following probing questions in the guide. The sessions were audio-recorded with the consent of the participants. A moderator in each session helped and facilitated the research.

Participants were asked to be retrospective because they had gone through that phase of high school and could better guide what they and their class fellows faced while opting engineering as a field of study. They were asked to relate problems which caused them trouble in their persistence and achievement in high school and then pursuing engineering or not at undergraduate level. The students at pre-engineering in high school level may not be able to report in detail as they were in high schools and did not know about the future outcomes of pursuing engineering and be persistent and successful in getting admission.

The data were transcribed, coded, and analyzed by using the thematic approach. The key stages in the thematic analysis given by Cochran and Patton (2002) were followed and were incorporated with the steps/stages given by Miles and Huberman (1994).

The explanations of the results based on focus group discussions along with the emerging themes are given in detail. The candidates first gave a brief introduction about themselves and the type of engineering course they are enrolled in.

Data Analysis

Thorough scrutiny of the transcriptions helped in generating meaningful themes. The five major techniques proposed by Kekeya (2016) were used including data organization,

generating meaningful units, construction of categories, developing themes and writing a theory.

Organization of Data

Organization of the data is very important for analyzing extensive qualitative data and quality management of the data (Creswell, 2007; Patton, 2002). The researcher organized each FGD separately and prepared documents for each focus group to represent the discussion in each focus group in word format. The sessions were transcribed, documents were copied and photocopied after revisiting several times so that the chances of error or misinterpretation or missing data could be dealt with in time.

Generating Units of Meanings

It refers to the discussion in parts, like the wordings used, the statements, expressions, symbols, etc. For example, to explain the term resilience, a student narrated that a person's hard work is important if knocked down he must know how to stand up again and face the situation which is important for a successful life. This was narrated by the participant as,*"yeh cheezain honi chahea zindagi k lea yeh chezain zaruri hain. hard work to chahea hota hay, lekin apko kisi ne knock out kia hy to ap kaho gay nahee ma wapis uthu ga to us k lea apko hard work chahea [These should be included in life, these things are important in life, hard work is compulsory, but if you are knocked down by someone, you will stand again for which you need hard work]".* Here hard work doesn't literally mean hard work but the courage to with-stand the hardships of life that was later explained by the participant. The coding of concepts was from participants' verbatim and created as statements by the researcher, conserving the original meaning that the participant wanted to convey.

Constructed Categories

It is the third level. Categorization was defined as "*a process whereby previously, unitizing data are organized into categories that provide descriptive or inferential information about the context or setting from which the units were derived"* (Lincoln & Guba, 1985, *p.* 204).

The categorization is basically done on the basis of similarities and differences in units determined initially through grouping together, linking concepts, and integration of the units on the basis of similar characteristics and recorded in a separate category if it is distinct in nature from the already defined categories. Modification was done several times to fit in the best category and their linkage with units is well defined as devised by Birks and Mills (2011). Ordering the categories is also beneficial to have more sense of the data and organization of the data (Mathews & Ross, 2014) and hence that was also done after completing categorization.

Developed Themes

In is stage the units and the categories are merged in respective themes (where they seem to fit in). It is a broad category that is developed by linking together the common categories based on characteristics (Hodkinson, 2008).

Theory Generation

This was not done as it was not the aim of the study.

Results and Discussion

The current research was based on the qualitative exploration of the factors associated with the students opting engineering field. The research was instrumental to explore these factors to promote engineering as an education and profession (Commission on Professionals in Science and Technology –CPST, 2007). The major themes emerged in the current study were academic and vocational interest, motivation, social support, personality characteristics, barriers etc. which are explained below separately for engineering and non-engineering students.

Psychosocial Factors for Engineering Students

The FGDs were started with a general question of career choice and participants were asked if they willingly chose engineering or not and were asked about their interest and choices. Majority of the participants reported that they opted for engineering because of parental pressure and not by their own interest. Majority of the students were forced to opt for engineering while students from Electrical Engineering were more dissatisfied with their choice. Students from Software Engineering were more interested in the field and were satisfied with their choice of field, despite of some concerns with the curriculum, administration, teaching, etc. The students from Mechanical Engineering were equal at both ends half of them were satisfied and chose their field by themselves while other half were forced to take admission in the field although their priorities were different in the career choices such as media, arts, photography, business etc.

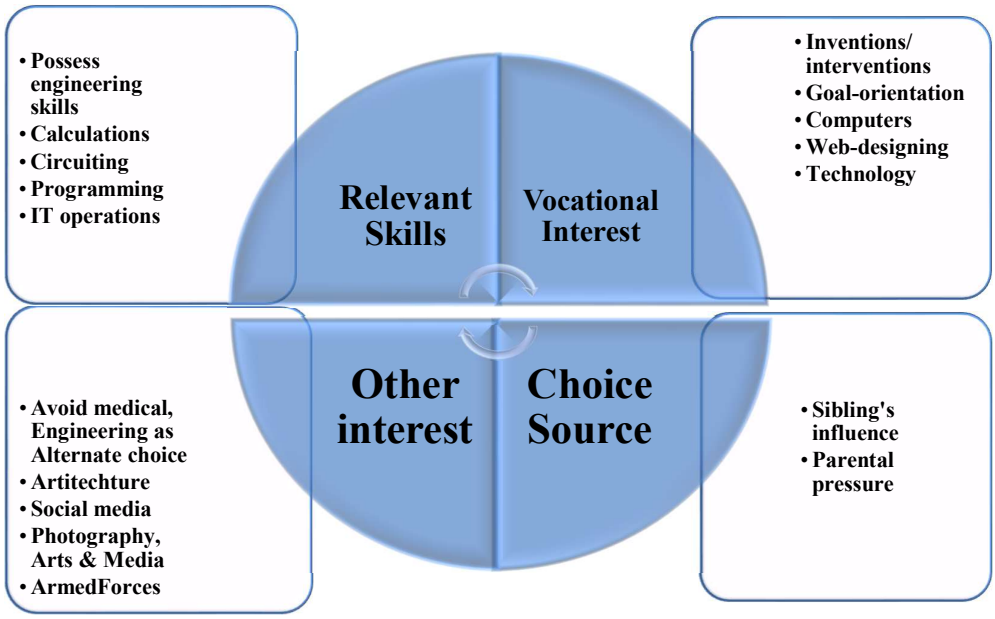
The below mentioned themes show the psychosocial factors for opting engineering. These factors are explained with their respective discussion to support with the existing literature. Some of the verbatim of the respondents are shared and other responses are summarized in the codes and description of the themes.

Interest and Skills

The first theme which was derived from the data was academic and vocational interest. The major categories as described in Figure 1 are skills, vocational interest and interest in other fields. Choice was also included under the theme of interest as it closely relates to it. Most of the students complied with their parents or siblings and chose engineering just to achieve the degree.

Figure 1

Perspective of Students of Engineering on Skills and Interest.



The literature mentioned above shows that interest is very important in career persuasion, success, achievement etc. This indicates that if students are interested in the field, they will pursue the field although not opted for their selves e.g., in the case of computer engineering and IT related engineering domains.

Few of the responses from the participants are given below. A male respondent studying Electrical Engineering (FG1-BEE-M4) said, *"...mere pas to koi option he nahee tha, abba ne kaha kar lo to., mera erada flying karnay ka tha. [I didn't have any option, father asked me to do this, so I did it., I wanted to fly (pilot)]".*

Another participant FG2-BEE-M3 responded on the same question as, *"Mixed tha, ammi abbu ka to dil tha lekin ma physics ma acha tha, thora tajassus tha k chezain kese hoti hain..phir thora push mila to agaya yahan [it was my choice as well as my parents wanted me to join engineering, I was good in physics, I was curious about working/operation of things then I got support so I came here]".*

These responses stated above are contradictory in their choices, one was totally not interested and wanted to join either air force or become a pilot but parental pressure resulted in selection of present field while the other participant had many supportive factors such as support from family, his own interest, curiosity as a factor of personality, skill of physics for pursuing engineering.

"Agar ap k F.Sc. ma achy marks ajatya hain to Engineering ko he saheeh decision mana jata hay" [if you have got good marks in FSc. (pre-engineering), then the right decision is choosing engineering].

The student FG-4-SMME-M1 reported that getting good marks at pre-engineering assures you for opting engineering where the student referred to the parental force and a no choice option on the basis of student's achievement. Another student FG-7-Bah-BEE-M3 reported as follows,

"Mere to father khud engineer banna chahty thy wo khud nahee banay to mujhy bhej dia jab kay mera koi interest nahee tha, magar unki khwahish k lea un ce deal ki k engineering karnay kay baad ma flying karu ga.." [My father wanted to be an engineer himself, but he could not be an engineer so he sent me to engineering although I did not have any interest, but to fulfill his wish I made a deal that I will do flying (piloting) after completing engineering].

Parental pressure could be evidently seen in the above response where the student wanted to go for another field but in order to fulfill his father's wish he accepted to study engineering with a deal to pursue his passion after the completion of his degree. Such examples can be seen in our society in abundance which was clear from the student's responses too.

As mentioned above majority of the students were forced to opt for engineering while students from Electrical Engineering were more dissatisfied with their choice. Another interesting but unfortunate finding was that majority of the students had alternate career plans in future after completion of their degree as this was only a commitment with their family. They wanted to switch later to army, business or some media related jobs. Many of them had no plans to pursue a career in engineering rather they were more inclined towards arts, entrepreneurship, gaming, etc. While the students of software engineering were more satisfied with their career as they found more scope in market and they always has an edge to secure themselves by online services if they do not get a job (even if not of their choice).

In the skills domain, the students who chose engineering reported that they possess the skills of engineering and they knew they were god in engineering related subjects but they were not fully aware as to how they knew they possessed these skills. Some of the students identified they were good in calculations, programming, circuiting, and IT operations. These were computer engineering/software engineering skills reported by the students of computer engineering.

The students of engineering chose engineering as an alternate option. Some of them wanted to avoid medical so they chose engineering because biology was totally out of their scope and engineering being technical and practical was more favored. Students reported that they wanted to join forces but were not selected in armed forces and hence joined engineering. Some of the student's primary interests were architecture, media, photography, arts, etc.

Factors important in developing interest in the field specifically in high school students were found to be parental influence and the knowledge of parent or significant others in that specific field. The current study highlighted the importance of parental factors in influencing a student in pursuing any field or profession.

The primitive factors in the persuasion of a field were the person's interest, their parents, the earning potentials (which are indicated in the value domain), and teachers respectively (Beggs, Bantham, & Taylor, 2008; Kuechler, McLeod, & Simkin, 2009). Interaction with people of the field is crucial for developing interest in the field, if a person has no interaction with the people from their field then there is a lack of interest. Knowledge of the field can make the decision easy for the student (Beggs, Bantham, & Taylor, 2008; Malgwi, Howe, & Bunaby, 2005).

Further participants were asked about the reason behind the choice of their respective field and if it was not their choice then what led them to opt for this field. The responses were interesting as they responded that they were good in mathematics, physics, calculations, circuits, programming, did pre-engineering, creative, curious, hard workers, adaptable, resilient, interested in inventions, intended to take help from siblings in the same field, and some considered it to be a second choice. For one of the students it was a dream and passion to be an engineer. A unique response from a participant was, *". Ma medical ma jana chahta tha..actually family ma bht zeada doctors hain is lea ma engineering ma agaya phir [I wanted to go in medical.. actually, there are many doctors in my family that's why I came in engineering then".*

Another participant said, *"Ma architect banna chahta tha magar nahee ban saka to engineering meri second choice thi yahan agay..[I wanted to be an architect but it didn't happen so engineering was my second choice so I came in it]"*

A student from computer engineering commented, *"Ma hamesha ce computer engineering karna chahta tha kyo kay is ma margin bohat hay creativity ka software kay through, is lea ma ab bhi apni filed ma interested hun [I was always interested in computer engineering because it has a lot of margin of creativity through software, that's why I have interest in the field]".*

Knowledge acquisition about a field was observed to be directly related to the person's own interest. If a student were not interested in a field, he would have never searched for the knowledge about that field. So, with every other factor personal interest enhances the worth and achievement in a field (Beggs, Bantham, & Taylor, 2008; Hall, Dickerson, Batts, Kauffmann, & Bosse, 2011; Kuechler, McLeod, & Simkin, 2009).

Extra-curricular activities such as field trips, exhibitions, workshops, etc. and peers' attitude influences a student's motivation and career aspirations too (McInerney, 2008; Vedder-Weiss & Fortus, 2013).

Motivation

Motivation is important in enabling and disabling the persuasion of any career. The consensus was on the stance that motivation leads to achievement, satisfaction, and boosts energy in an individual to pursue his/her goals whereas de-motivation limits or retards their growth and achievement by lowering their zest towards understanding, gaining knowledge, and achieving their particular goals in life or academia.

STEM fields have numerous of deficiencies at different levels like educational, career and opportunities available and stereotypic attitudes of the people. Generally, STEM fields are associated with men, and this majorly limits the scope and educational growth of girls in the field.

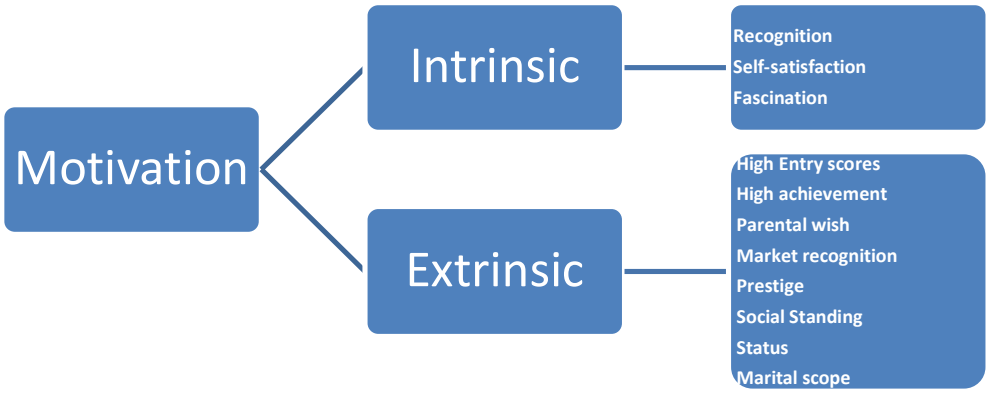
Motivation can be measured at the beginning of engineering particularly in courses like mathematics which are the major courses for engineering. Students who are meta-cognitively aware of their motivation are better equipped to self-regulate their science/engineering-learning behavior (Schunk, Pintrich, & Meece, 2008).

Three major domains of motivation that were identified by the students are intrinsic, extrinsic, and amotivation. Intrinsic motivation was more positively related to achievement,

satisfaction, and success. Sources of extrinsic motivation are parents, teachers, and peers. Extrinsic motivation is more related to external factors like prestige, social recognition, and values as an outcome. Demotivating factors are negative factors serving as barriers that cause hindrance in the path of engineering education and were coded under the themes of barriers. These factors are mentioned below in figure 2.

Figure 2

Motivation as Perceived by Engineering Students



Among the intrinsic motivation, mostly students identified that high achievement was a source of motivation for them. Internal satisfaction by securing admission in engineering is another factor as it was their dream and passion to join engineering. Extrinsic motivation was subject specific achievement in math and physics that one required for entry test to acquire admission. People around them such as friends, family, and teachers provided encouragement and support to get motivated which is an external source of motivation.

Parental pressure was a key factor throughout the study and most of the students joined engineering to fulfill the wishes of their parents. Studying engineering is much appreciated as it is a renowned field that symbolizes dignity and honor and it has a good impression on others in society. It may help in gaining a high status in the society and may help in good marriage proposals. These were all the extrinsic motivation factors reported by the students for studying engineering.

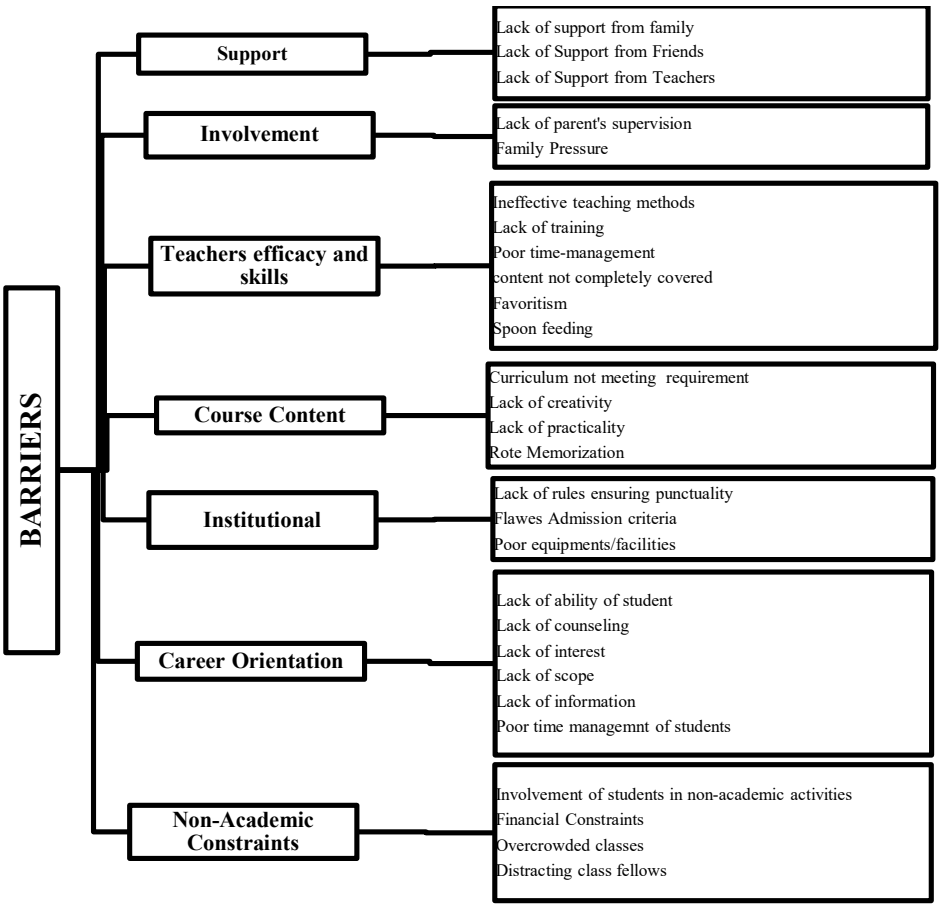
Amotivation, on the other hand, has a negative impact as it limits growth, achievement, and goal orientated behavior. Significant others such as friends, family, and teachers are considered highly motivating which leads to depressiveness, low energy for coping with stress and retards growth significantly if motivation is not available.

Barriers

Responses identified as barriers were of two types, one that were related to pre-engineering and the second were related to engineering after passing pre-engineering or after joining engineering field. As our scope of study was to identify the barriers faced in pre-engineering so the themes and categories were purely extracted for pre-engineering related issues.

Figure 3

Barriers in perspective of Engineering Students



Categorically, barriers faced by students were support, involvement, teaching efficacy, and skills, course content, institutional barriers, career oriented, and non-academic barriers. The lack of support as established in the study referred to the constraints faced by students due to the lack of support from friends, family and teachers, considered as the significant others in the area of career selection, aspiration and selection. Non-involved parents in the educational affairs such as lacking supervision in educational affairs, pressure of opting a field against the student's will were some of the aspects that limited the growth of the students and hence acted as barriers. Some of the participants viewed that the existing stereotypes that the only respectable and renowned fields are medical, engineering, and IT also served as a barrier to success, students cannot go for the fields which they are interested in and may guarantee success for them.

Field work, effective guidance and updated course can reduce the barriers and can play some part in achievement of the participant. Among the challenges faced by the students that could be considered as barriers were time management for the unlimited projects, lack of supervision, difference in annual and semester system, lack of (career) counseling, getting lower GPA, institutional choice, torturous environment (bombardment of projects leading to mental illness), and personal issues of the students. A few students reported that the barrier is mainly the marks in pre-engineering, they intend to take admission, but they could not

because of their ineligibility.

Extreme comments by some students reflecting their sufferings because of the barriers they face are discussed. A student commented that *"Course abhi tak update nahee hua, hum abhi tak C++ ma phansay hue hain jab k kai new languages aa chuki hain jin ki market ma demand hay. [Courses are not yet updated; we are still stuck in C++ where new languages which are demanded in the market are there (which are not taught)]"*.

Another response from a student is, *"Engineering ek torture cell hay or bus. [Engineering is a torture cell and that's it]"*. Another response states that, *"Teachers bohat tough time dety hain students k seekhnay k lea jis ce seekhna ya learning torturous ho jati hay. [Teachers give a tough time to students due to which learning becomes torturous]"*.

One of the respondent gave an opinion while pointing out the barriers such as, *"Projects ko well-guided hona chahea or semester k shuru ma he dy dena chahea na k end ma sab dy dain ta k time ko manage kia ja sakay [Projects need to be well guided and should be given at the start of the semester not in the end so that time could be managed]"*.

These responses were mainly referred to the Engineering related issues for which further probing was done about the problems while studying at pre-engineering level to which a student responded, *"Same hay wahan bhi end pe yad ata hay kay tests bhi lene hain, practical copies bhi banana hain sendups bhi dene hain pre-boards bhi dene hain, ye sab start ce manage hone chahea end pe nahee [it is the same for pre-engineering as well, they remember that tests are to taken, practical copies have to be completed, sendups and pre-boards are to be given and all of these should be managed from the start not at the end]."*

Barriers related to teachers were also important in the view of students as they reported that teaching skills and efficacy are important in pre-engineering. Ineffective teaching methods are also a barrier because it fails to produce spark in the students, or to motivate them. Teachers need to be trained for effective method, time management, content coverage, unbiased consideration of the students, and promoting creative work rather than spoon feeding. These factors not only help at pre-engineering level but also during the admissions process for universities and later.

Course content was also reported to be outdated and not updated/upgraded since decades. The content and teaching scope were mostly exam-oriented not career-oriented, cramming/rote memorization is mostly followed and conceptual clarity is lacking. Major content of the course is based on numerical analysis and practical orientation is scarce.

Education system itself, can be a barrier, it focuses on selected topics and ignores others, giving importance to the board marks not the understanding for which students shift to academies. Students reported that teachers only covered the content which appeared in the board exams repeatedly and ignored the numerical portion which was the basis of theoretical understanding. Lack of practical orientation by ignoring numerical portion leads to rote memorization which later leads to students failing entrance exams as they lack clarity of concepts. The outdated course content which restricts knowledge and practicality, increases the risk of suffering in education and in practical fields in the long run.

The attendance policy is not very strict, and students majorly bunk their classes and later on refer to notes to cover the content they missed in schools/colleges thus affecting their concept formation. So, attendance if not made mandatory for the students can make them suffer in academics and later on in their careers.

Field work, effective guidance, and updated course can reduce the barriers and can play some part in the achievement of the participants. Among the challenges faced by the students that could be considered as barriers were time management for studies, lack of supervision, lack of (career) counseling, getting lower grades, institutional choice, and personal issues of the students. A few students reported that the barrier is mainly the marks required to take admission in pre-engineering as they intended to take admission but could not because of their ineligibility.

Research study suggested a comprehensive knowledge of the field at matriculation and higher school levels is very important to pursue a career in engineering. They have discovered that about 300,000 students enter college without declaring their majors and this rate of non-declaration of the field and major domain is even higher in matriculation. Research findings also indicated that the persistence rate in pre-engineering is higher than other fields (Donnelly & Borland, 2002; Ohland, et al., 2008) which was not the case in the current research as majority of the participants clearly mentioned shifting the main field and preferring alternatives than pursuing the same field.

According to literature, students from software engineering (Ohland et al., 2008) shifted to different majors/fields which was opposite to the findings of the current research where the students of software engineering were more interested to pursue the field than others. They shared that they were persistent to start their own business and start freelancing in the field in case they were unable to find jobs relevant to their majors.

The reason for this might be the increase in technology and more information available to the students, or the curiosity to have the knowledge of the mechanism behind the technology as mentioned by few students directly. Initially students are not very clear regarding what to choose and how to pursue a specific field that might be the reason for the shift in the majors. The trend of guidance and counseling is not prevalent in Pakistan particularly which can guide students about the path to follow for attaining the degree in relevant fields as per their interests.

The key motivators are the teachers and parents which are effective support system. According to various studies (e.g., Jackson & Nutini, 2002; Kenny, Blustein, Chaves, Grossman, & Gallagher, 2003; Hall, et al., 2011), a career support system in educational sector plays an important role in managing negativity as parents do not suggest or guide but force their children to opt for a particular career or subject.

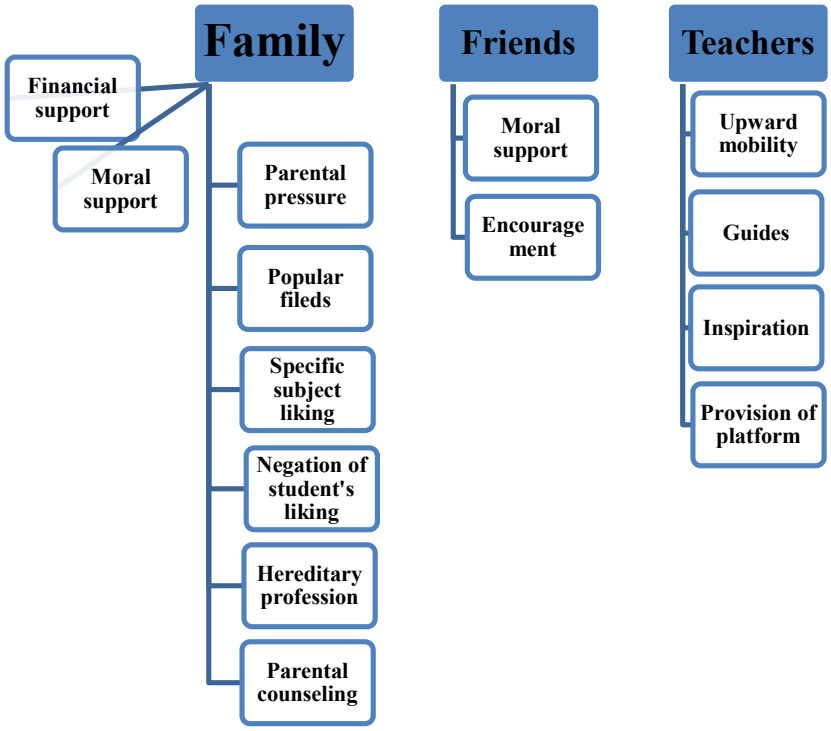
Research by Hall et al., (2011) indicated that the rate of entrance in the fields of STEM is not at par with the needs of the market (Commission on Professionals in Science and Technology –[CPST], 2007; Lowell & Regets, 2006) and suggested that counseling is needed to improve the understanding of the implementation of the fields. Career access can be improved in STEM fields by better guidance.

Social Support

After the barriers were identified, it was important to understand the perception of the participants about their supporters or their support system. The social support identified by the participants is discussed in figure 4.

Figure 4

Social Support in Perspective of Engineering Students



Most of the students considered their family as their financial and moral support, friends were identified as moral supporters and motivators and teachers were identified as guides. Support from all these mattered a lot to them. Moreover, they said that if their parents, teachers, and friends de-motivated them then it results in poor academic performance and less energy to cope with the stressors discussed in amotivation earlier. Some of the students hold teachers responsible for not motivating or a motivating their students which can also result into problems for them. Authoritarian parenting style perceived as display of love, warmth, concern in the collectivistic culture also leads to demotivation (Mousavi, Low, & Hashim, 2016). One of the response (FG-3-M2) regarding social support from a participant is, *"Teacher ki qualification bohat karti hay 30-40 percent or uska teaching method 70 percent matter karta hy bachon k lea..school system or teachers highly demotivate kartay hain qk unkay standards ko meet karna asaan nahee hota is k lea qualification bht zaruri hay jo zeada tar private idaron ma nahee hoti [Teachers qualification matters between 30-40% and his/her teaching method matters 70% for the students in a school system. Teachers highly motivate or de-motivate because meting their (educational) standards (demands) is not easy that is why qualification is very important which is not present in most of the private institutions"].*

Family, friends, and teachers play a major role in the support system of a student. Family was the major influencer as they support morally as well as financially. Their influences are in subject choices majorly, they want renowned fields and specific subjects to be selected by their children. They negate or do not allow their children to choose subjects of their interests. Students identified that parents need to counsel along with students to know the worth of other fields and importance of interest in choosing an academic field.

Moreover, prior literature says that teachers and friends provide a platform for growth, achievement, and moral development. Reciprocal friendships contributed to the prediction of dropping out of high school, above and beyond the effects of academic motivation, or parent and teacher support for basic psychological needs. Although parent support for basic psychological needs appeared to be the most significant predictor of academic motivation and dropping out of high school, results suggested that reciprocal friendships represented an important factor that affect both motivation and persistence (Song, Bong, Lee & Kim, 2015).

Support system is a mandatory primitive factor in career aspiration of a student at crucial turning points like matric and F.Sc. level, without the encouragement of parents, teachers and friends students will not opt for STEM fields and therefore their support is needed (Hall, et al., 2011; Daugherty, Reese, & Merrill, 2010; Daugherty, Westrick, Zeng, Merrill, & Custer, 2007). Teachers' qualification has a huge influence on the student's support system; their teaching method and effective guidance can act as support for achievement.

Social support and other social-contextual factors were also examined, such as support from parents, peers and teachers which enhances self-efficacy of the students of engineering fields (Bandura, Barbaranelli, Caprara, & Postorelli, 2001). Positive involvement of parents leads to higher academic achievement as supported by social cognitive career theory (Clotfelter, Ladd, & Vigdor, 2007).

Personality Characteristics

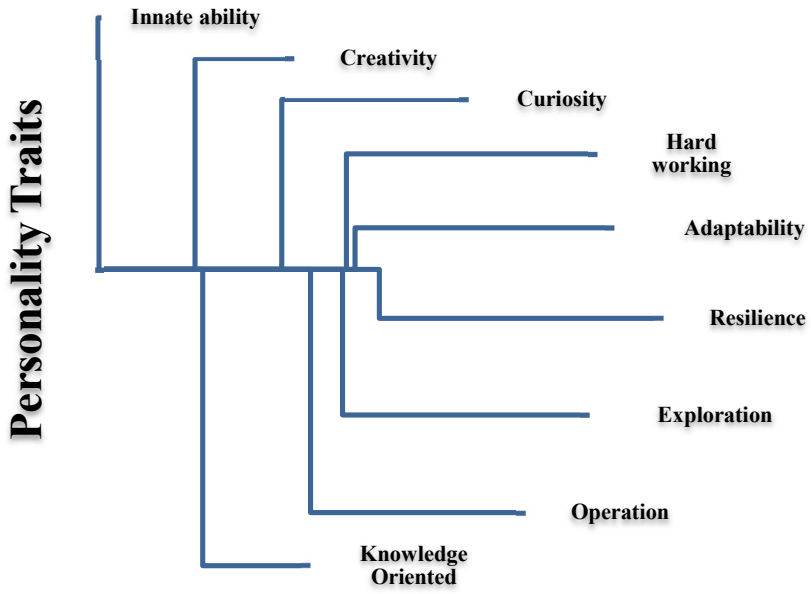
Personality depicts the characteristics that are required by pre-engineering students to pursue engineering as a career successfully. The personality characteristics identified by students are that they must be creative, curious to explore what is going inside the obvious, work hard to reach a goal. They need to be resilient so that their failure does not result in hopelessness and they can start with the same energy over again. Students also said that they need to be adaptable to adjust to the circumstances and change themselves according to the need of the hour as they may not be favorable always. They must possess interest in programming, mechanics, numeric, electrical appliances etc. depending on their selected major. As a respondent FG-4-BEE-M2 said *"Zeada parhai ki taraf tawajah nahee dety thay q kay pata tha k abhi saal para hy akhir ma parh lain gay or nikal jayengy achy grades k sath. Sahi tarah 2 haftay bhi parthy hain to marks ajatya hain." [Did not concentrate on studies as we knew that we have a year time and we will cover in the end and will get through with good grades even if we study for 2 weeks we can gain marks].*

The above response explains the respondent's attitude towards studies at pre-engineering level. Annual system gives them the leverage to cover up all the content at the end of the session and pass through. This was the attitude of majority participants; some were satisfied with the attitude and some regretted that they wasted time when they had the opportunity to learn and achieve even better. This is depicted in the response of FG-7-BEE-M3 *"Parhai ma koi interest nahee tha pehly to airforce colony ma rehty thay sahii danday k zor ce seedhay rehty thay magar jab bahir nikly to maza aya doston k sath phir parhai ma interest khatam ho gaya jis ka pachtawa hy".[Did not have any interest in studies, lived in air force colony initially so were forcibly right because of the strictness (studious) but when got out from there, enjoyed with friends and lacked interest in studies, which I regret].*

Participant's regret explains that he wanted to achieve even higher and be in the right direction but he was involved with distracting friends (mentioned in the barriers) which limited his achievement and he thus needed to put in much more effort to secure admission in engineering college which would have been more easier if he got higher grades than the currently achieved grades at pre-engineering level. The figure 5 below explains all the personality characteristics that play a major role in opting pre-engineering.

Figure 5

Personality Traits in Perspective of Engineering students



Values and Academic Achievement

Values meant the reason behind favoring or approving something (with reference to engineering). There are different values assigned to every career and field but what specifically was associated with engineering was the students' interest majorly, limited choices, parent's wish, high grades in FSc. etc. Some other different views about engineering were that it is a symbol of dignity and honor, is related to good impression management, high place in society, the worth of the degree is a lot and lastly it helps in getting good partner (*Rishta*). A respondent commented that *"Degree is worthless is ce hamain koi faida nahee hona is lea we have to go for alternate options [Degree is worthless it does not give us any benefit that is why we have to opt other options]*". The above response shows that the participant does not perceive any value of engineering degree and is ready to choose alternatives as a career other than his main field of study. The prior literature also says that Beggs, Bantham, and Taylor (2008) discovered various factors related to career or field choice which include personal interest (on the top), parental and teachers support (as mandatory factor in choosing a tough field), relatives, guides, friends, opportunities, salary expectations, advancements, benefits, the reputation of the staff, course content, and ease of earning a degree is varyingly important for different students of college level. Academically high grades are important specifically in the subjects related to engineering such as mathematics and physics but also the overall grades required for admission in pre engineering

need to be high.

Psychosocial Factors for Non-Engineering Students

Same themes (i.e. academic and vocational interest, motivation, social support, personality characteristics, and barriers) have emerged for non-engineering students as for engineering students but the difference lies in the underlying factors and categories that are explained below.

Interest and Skills of the Students

The categories emerged under the theme of vocational interest are field interests, alternative fields interest, and skills. Three students from non-engineering fields responded in their field related interests. Their interest was primarily in physics, electronics, and mathematics. A student explained that from childhood he used to work as an electrician, and he used to fix things at home and for other people. He was interested in physics related equipment and used to work with keen interest in the laboratory. The lab attendant and the teachers also used to lend him keys of the laboratory to perform his activities whenever he wanted. All these responses show his interest in the field of engineering but due to the lack of theoretical knowledge, some financial issues, and non-selection he could not pursue his field of interest. Other engineering related subjects of interest were computer science and Mathematics mainly.

Some students reported they were not interested in the field of engineering although they had good grades and opportunity to pursue the field of engineering, but they were not interested. The students from English department were all interested to appear in competitive exams and wanted to become Central Superior Services officer or join Armed Forces. Some of the students were interested in pure arts (like sketching, music etc.).

A student from FG-2-Eng-M1 said, *"Mujhy engineer ban'na he nahee tha myjy to CSS karna tha bus maths achi the two is lea medical ki jaga F.Sc. Ma engineering li thee. [I never wanted to become an engineer, I wanted to do CSS, I was good in mathematics, so I opted engineering instead of medical in F.Sc.]".*

The skills that were mentioned by the students that they possessed for engineering were, a good practical knowledge, they participated in different science projects and won prizes, they had the skills to mend electrical appliances, they were curious and explorative and wanted to get the knowledge about the latent details of an appliance or equipment. Majority of them reported that they had mathematical skills and some of them even got 100% marks in mathematics but were not interested to pursue engineering as they did not like the field to be pursued as a career.

Another response from a student of psychology, FG-1-Psy-F1 stated, "*Meri behen ne kaha kay engineering ly lo asan hota hy pre-medical ce marks achy ajaty hain or baad ma change kar sakti ho..[My sister suggested to opt pre-engineering as it is easier than pre-medical, higher grades (marks) could be achieved and you can change it afterwards]".* The respondent above explained that she wasn't willing to join pre-engineering but on her sister's recommendation she opted for pre-engineering because of her sister's perception that it would be easier to obtain good marks

.

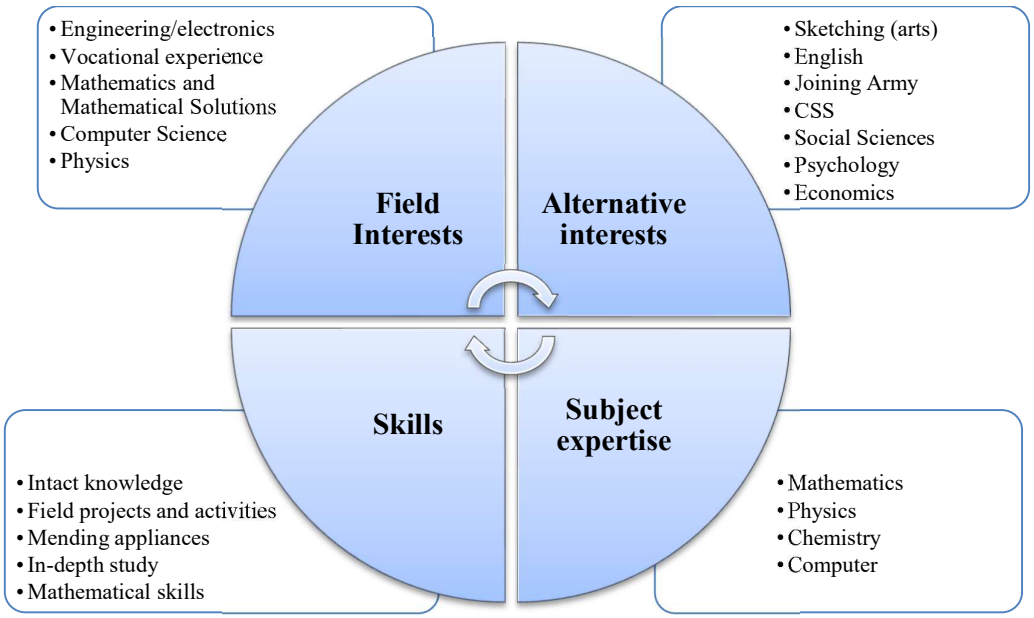
Students from non-engineering fields, who studied pre-engineering and did not pursue the field of engineering, had different opinions in interest from those of engineering students. Some were interested in persuasion of the field and majority decided earlier to pursue non-

engineering fields besides having high grades. The domains of interest other than engineering were both scientific and non-scientific. Boys scored high in mathematics and physics, had high self-efficacy in engineering related fields but they did not pursue their career in engineering as they were not interested in becoming engineers.

The reasons for pursuing a higher education in engineering and non-engineering were different. Majority of engineering students were forced to choose engineering which was less evident in the non-engineering students. Non-engineering students had different situations, some of them did not want to continue engineering, some were good in studies and wanted to join alternate fields and some were suggested to join engineering but not forced for doing so. Those who wanted to join engineering were either hindered by the financial constraints or personal failures. Factors related to interest and skill for non-engineering students are summed up below in the figure.

Figure 6

Interest & Skills in Perspective of Non-Engineering Students.



Barriers

In the present study, the categories identified from the focus group discussions of the non-engineering students are personal factors, family factors and institutional factors. The students reported that they faced certain barriers while studying engineering such as achieving lower grades in pre-engineering, poor theoretical knowledge which led to non-qualification in admission test for engineering, so they changed their subject. They accepted that they could not manage time properly for studies which made them land in trouble while securing grades. They only prepared for exams during vacations for preparation before board exams.

Few students identified some other personal factors that affected their grades in pre-engineering such as memory issues and their writing. They reported that they could not remember the technical terminologies, and this affected their grading in examinations.

Having poor handwriting also affected their grades as their papers were illegible. For some students, solving physics and mathematical problems was a barrier in securing good grades.

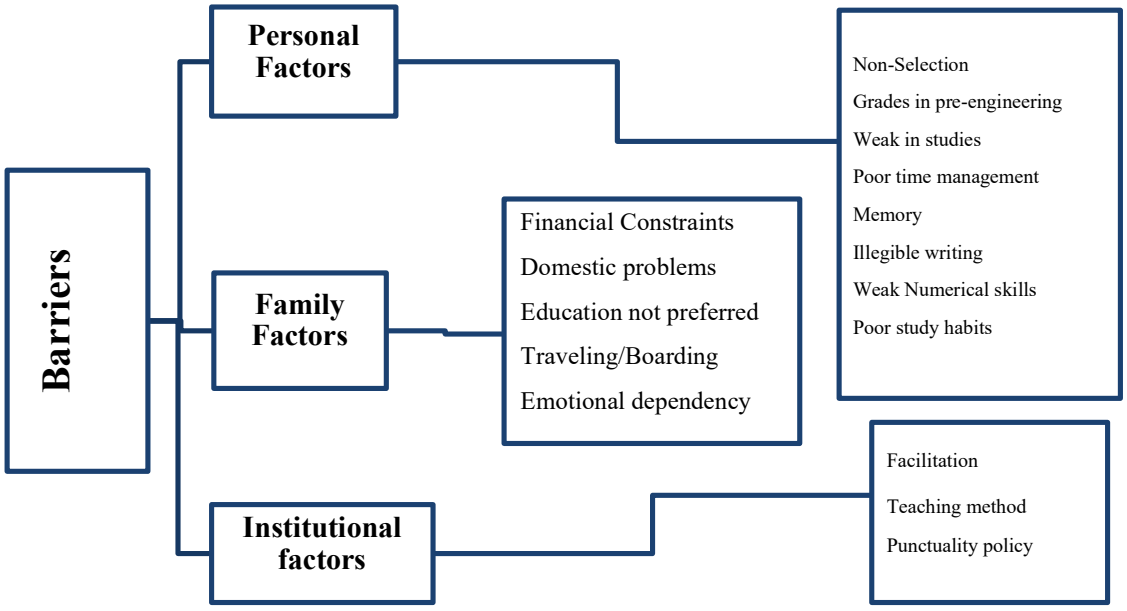
Family factors also contributed to the failure in pursuing engineering. Financial constraints were among the most prominent factors. A student reported that his family did not have financial issues and they are well settled but financing studies are not preferred by the family. Two of the students explained that they had to work and earn as well as study so could not manage time properly for studies. One of the students said that he was interested in medical but due to financial constraints his family denied him to get admission in medical so he changed his field to engineering which he could not pursue either due to financial issues.

Some students reported that their domestic issues (like family events, domestic problems, etc.) also affected their studies as they were frequently required to travel home during the academic year. One of the students from English department was an only child and due to the emotional dependency of his parents, he could not move out of the family to pursue engineering as a field.

Educational/institutional constraints were also held responsible for not pursuing engineering fields such as poor laboratory facilities in the institute, poor teaching methods, and lack of rules for punctuality. The psychosocial factors related to barriers in the perspective of non-engineering students are given below in figure 7.

Figure 07

Barriers in Perspective of Non-Engineering Students



Some of the factors mentioned above are highlighted by prior literature. Ali, Iqbal, & Akhtar (2013) found parents socio-economic status, and students self-concept and gender as important factors in influencing students' attitude towards science. Teachers help students in their studies, some studies have indicated that personality and behavior of the

teacher is very important in the formation of a student's attitude. Most researchers (Nieswandt, 2005; Hazari, Simon, & Collins, 2003) consider the effects of curriculum on the scientific attitude of a child. Studies highlighted the importance of many factors that inculcate positivity in students for a subject specifically, natural sciences. Teachers, peers and parents are important support groups for the student to pursue a field but if these support systems do not provide the necessary support to the individual that will act as a barrier for the achievement and persistence of the student. Same is the case with economic conditions of the parents, high or middle economic status will serve as support and lower-middle and lower economic status will cause hindrance in the achievement and persistence of a student in pre-engineering.

The differences in the perspective of engineering and non-engineering students regarding the barriers was also observed. The barriers in perspective for the engineering students were lack of support, poor parental involvement, teacher related factors, content related, institutional, career orientation, and non-academic. On the other hand, personal factors, domestic issues, and some institutional factors contributed as a barrier for non-engineering students. Hence personal inclinations, personal weaknesses and failures were included in the non-engineering barriers.

Pakistan is facing various challenges which are contributing towards its instability and a major factor contributing to these challenges is a poor education system and science education. The quality of education is declining day by day and needs an urgent improvement which was attributed to factors such as budget, teaching, qualification, support, content, and inadequate researches (Memon, Joubish, & Khurran, 2010). Pakistan needs to draw on possible lessons and ideas that have proven to be of value such as innovations in science and engineering education and factors related to these fields (Marginson, Tytler, Freeman, & Roberts, 2013).

Support System

The students who did not pursue the field of engineering were either not interested or not supported by their parents because of their financial constraints. Although parents forced some of the students to opt for engineering, but the students had a clear vision and awareness of the field as well as their fields of interest hence chose a field of study accordingly.

The major categories related to support system are influences, counseling, and role models. In the support system, parental non-support and pressure was much highlighted. A student reported that her father forced her for medical although she did not have the aptitude for medical studies. One of the students had to leave studies multiple times during early education due to parent's lack of support in pursuing studies. Another student said that he was forced for doing technical diploma to learn quickly with lesser expenses and do an engineering related job which was not acceptable to him.

Career counseling was noted to have an influence in one's career and career choices. A student from English department whose father was in teaching field supported his child in choosing a career that suited his interest. The student was a high achiever and had the skill and aptitude of engineering but wanted to appear in competitive examination and had full support from his family. Such examples were rarely found in the study in both engineering and non-engineering FGDs. the participants highlighted the importance of counseling not only for the child but also for the parents to promote and guide their children in the direction of their aptitudes and interests. One participant, FG3-Eng-M5 said that, *"Career counseling*

to bht shuru ma honi chahea jese 5th grade he ma ho jaye ta kay bachy ko pata ho k usko kis direction ma jana hay or wo counselor k mashwaray k mutabiq us field ma jaye ta kay kamyab bhi ho sakay, mere to parents ne bht clearly guide kia to mujhy koi mushkil nahee hue sochny ma k mujhy kia karna hay agay. Kuch parents nahee samajhty bachy ka interest apni marzi musallat kartay hain [Career counseling should be done at an earlier stage like in 5th grade so that the child knows his direction and consider counselor's advice in choosing his field so that he may be successful, my parent guided me so well that I didn't have any trouble in thinking about my future goal. Some parents do not understand their child's interest and impose their will on their children]".

Participants of the FGDs highlighted the importance of professional guidance not only for subject or career selection but also for school and college selection as some of them suffered due to a lack of goal directedness and lack of decision-making power. There were a difference of opinion among participants as to when career counselling should be provided as some recommended to start it as early as in the 5th grade, some recommended before matric others recommended post matric at the time of subject selection at Intermediate level.

Role models are found to be helpful in choosing fields of education (Boucher, Fuesting, Diekman, & Murphy, 2017; Fuesting, & Diekman, 2017). However, in the present study only one participant mentioned that he was impressed by a psychologist in Inter Services Selection Board, hence joined psychology and another student mentioned that he wanted to follow Einstein not to give laws and theories but to make some contribution in the scientific field. A study was conducted in Sargodha to examine the attitudes of students towards social sciences. The results of the study revealed that students had less information about social sciences because their teachers, parents and peers did not tell them about these subjects and their worth in the society and therefore they were more interested to study natural sciences rather that social sciences (Ahmed et al., 2016).

Once engaged in a task or activity, a student's interest can be further influenced by the social environment in which the task takes place. For example, when students with a high interpersonal orientation (i.e., individuals with a preference for social interaction) worked with or alongside others on a task, they expressed greater interest in the task and in engaging in similar tasks in the future (Isaac, Sansone, & Smith, 1999; Sansone, & Thoman, 2005). Subsequent research has demonstrated that even subtle social support outside of the presence of others can increase task interest (Carr & Walton, 2014).

Support system was different in the perspectives of engineering and non-engineering students. Lack of support from family, friends and teachers were identified by engineering students and other family related constraints were described by the non-engineering students at the time of career selection.

Motivation

Most respondents stated that their parents motivated them to study natural science subjects because they claimed that those who study natural sciences get attractive and high paying jobs than those who study social sciences (such as Ahmed et al., 2016). Students think natural sciences have more scope and are economically beneficial and more than half of the students study natural sciences for the sake of earning money. Mostly this attitude is driven by their significant others.

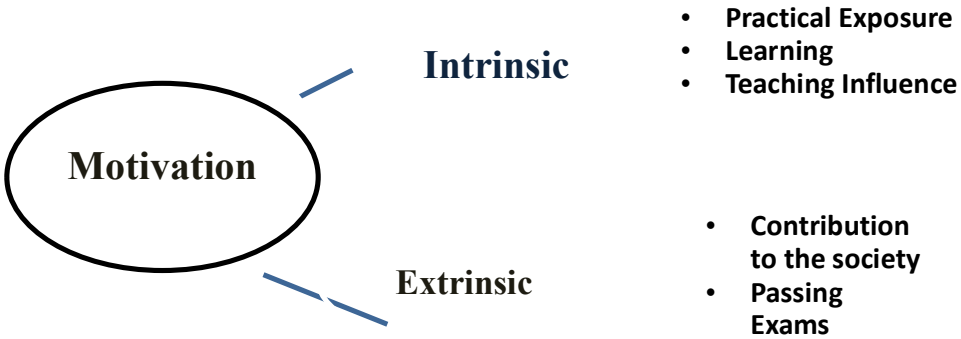
Students who had high aptitude in mathematics were motivated by teachers to pursue engineering, but they decided to follow their fields of interest and opted according to their own choice despite of continuous efforts by their teachers. The reason the participants claimed was that they were clearer in their mind about future goals and career orientations. They were motivated for the subjects they chose and studied whole-heartedly with interest. Student FG2-Eng-M1 reported that, *"Ma mathematics ma bht acha tha 100% marks atay thy mere to teachers ne bht motivate kia k engineering kar lo magar mera erada pakka tha mujhy CSS he karna tha is lea English ma agaya. Magar teachers ki motivation ce parhai ka shoq barhta raha [I was very good in mathematics secured 100% marks so teachers always motivated me to join engineering but I was determined in my intentions, wanted to do CSS thus chose English. But with teacher's motivation, interest in studies increased]".*

The participants identified their motivational factors which were categorized as extrinsic and intrinsic in the study. Some of the participants said for them having practical exposure motivated them intrinsically. To gain extra knowledge or study in order to learn, intrinsic motivation was considered important. FG1-Psy-M1 said that, *"Mane jo bhi parha hay kabhi marks k lea nahee parha balkay samajhny k lea parha, khud k interest k lea parha, sirf kitab ce nahee balkay jahan ce bhi knowledge mil sakti the mane hasil ki [I did not study for marks but for my understanding (learning) and for my personal interest, I studied from different possible resources besides course books]".*

The participant directly referred to his intrinsic motivation for studying and was very satisfied with his academia because he was not in competition with others but studied to satisfy his own need for knowing and learning. These factors are summarized in the figure below.

Figure 08

Motivation in Perspective of Non-Engineering Students



The participants identified their motivational factors which were categorized as extrinsic and intrinsic in the study. Some of the participants said for them having practical exposure motivated them intrinsically. To gain extra knowledge or study to learn, intrinsic motivation was considered important. Extrinsic motivation at the pre-engineering level was to pass exams for some students, or to contribute to the society.

Motivation was also different from the perspective of engineering and non-engineering students. The motivational factors were limited for the non-engineering students

and confined to grades, learning, contribution to society and passing exams, but all were unrelated to engineering. There were a lot of factors contributing to the motivation of engineering students and they were mostly extrinsic rather than intrinsic.

Academic Satisfaction

The satisfaction of students is based on intrinsic motivation, interest, and practicality. The more a field is clear in its practicality the more it is satisfying as it clarifies the goal and purpose. A student from Psychology FG1-Psy-M3 said that, "*Subject jo marzi ho engineering ho na ho agar us ma practicality ho to wo satisfaction ka bais banti hay phir samajh bhi ata hy k ye jo hum karay hain kis lea karay hain, hum ce pehly logo ne kese kia, naya kia kar sakty hain, to ye zaroori hy har field ma [Whatever subject it may be engineering or not but if it has practicality it is the basis of satisfaction, then we can understand what we are doing, why we are doing this, how did people do it before, how could we apply innovation, and this is important in every field]".*

Academic satisfaction of the non-engineering students was high except for a group of students from electronics. Satisfaction was more related to qualified teachers and updated equipment in pre-engineering studies by the students.

Factors identified as contributing to high academic satisfaction were practical implementation of course, high achievement in the form of grades which boosted their confidence as well as satisfaction. For participants who did not intend to pursue the field of engineering academic satisfaction was joining their fields of interest after doing pre-engineering, and while doing pre-engineering achievement in the form of grades was a satisfaction factor for them.

These factors are also supported by prior literature as students' satisfaction with their studies is an important matter for them, their teachers, their institutions, and public bodies. In a review of over 7000 publications, Richardson, Abraham, & Bond, (2012) classified 42 non-intellective correlates of academic performance into five classes: personality traits, motivational factors, self-regulatory learning strategies, students' approaches to learning, and psychosocial contextual factors. These, so-called non-intellective factors represent sites of psychological or educational interventions that aim to enhance students' engagement and satisfaction with their studies (e.g., teaching study techniques according to approaches to learning).

The satisfaction level of engineering students was very low as compared to the non-engineering students except for the field of software engineering. The students of non-engineering were more satisfied in their respective field except for the field of electronics.

Persistent Intention

Factors for those *persisting* in engineering were intention to stay in engineering, determination, self-regulating behaviors, coping skills, grades, and mental preparedness. Most students faced difficulties in the transition to a more academically challenging college program. Suggestions were made for the development of retention programs that would concentrate on helping students become better prepared mentally for the rigors of an engineering program and help students manage the transition to an engineering major (MacGuire, & Halpin, 1995).

The persuasion of an appropriate career is a big issue for adolescents. A rapid decline in enrollment or an attrition after enrollment is observed in STEM fields. (Lam, Srivatsan,

Doverspike, Vesalo, & Mawasha, 2005). A student from psychology FG1-Psy-M1 explained this as,*"Main to taqreeban bachpan ce yani 13 saal ce electrical appliances ka kam kar raha hun mujhy pasand hy mgr ma kuch different karna chahta hun scientist banna hy mujhy magr social science ma psychology ma, mujhy logon ko study karna acha lagta hay psychological phenomenas achy lagty hain. Han agar mera admission ho jata engineering ma ya physics ma to wo bhi kar leta qk wo bachpan ce meri field hay mgr psychology ma bht khush hun itna khush shaid kisi or jaga na hota [I am involved with electrical appliances from very childhood means from 13 years and I liked it but I wanted to do something different, I wanted to be a scientist but in the field of social science, in psychology, I like studying about humans, psychological phenomena. Yes! If I could have admission in engineering or physics, I could have done that too because that was my field from childhood, but I would not be as happy as I am in psychology]".*

The clarity of choosing a field and intension for persistence is very clear from the above comment. Social science was chosen as the field of interest and a very determined intension is evident from the way of his comment. This intensity and clarity were missing in engineering students other than software engineering students. They were either forced or were not clear about their future career aspirations but somehow joined engineering.

The students from non-engineering fields other than electronics did not intend to persist in engineering fields and hence changed their major's despite of high achievement, motivation to studying, and high self-efficacy. They reported to be satisfied and adjusted in their new fields.

Persistence intension was similar in both the groups as both did not want to pursue their academic careers except few participants. The non-engineering students did not want to pursue the engineering fields (except electronics students) and the students of engineering besides doing software engineering did not want to pursue the field of engineering as a career as reported by the majority of students from engineering field.

Academic Achievement

Participants reported that engineering field demands hard work and a proper study routine. However, in the analysis earlier it was identified that students secured high grades by only studying during the study break before exams and they believed in their self-efficacy. Different factors identified by the students who could not secure admissions in engineering included lack of concentration, stress, involvement in non-academic activities, and non-serious attitudes etc.

Some of the study habits identified by the participants were that they arranged the material systematically and then studied while focusing on the content and not the grades, because according to them striving for marks and grades causes stress. They also pointed out that hard work and studying from other sources rather than only course books enhances knowledge, makes thing clearer, guides for more practical methodology and promotes teaching skills for helping others.

The reasons identified for failure or low achievement were; lack of concentration towards studies, casual attitude while deciding subject, non-serious attitude towards studies as well as exams, involvement in non-academic activities, (like social media, movies, games etc.) and stress or burden due to either academics or personal reasons.

For the students of engineering grades were their achievement and that was the only goal while for non-engineering students studying, learning, gaining knowledge, helping others etc. were regarded as their achievements.

Values

The value actually refers to the expectations from a field as an outcome that may be extrinsic or intrinsic. Here extrinsic value for the participants was grades and the intrinsic values were that their education may contribute positively to the society and they can get internal satisfaction by studying in their fields of interest. Their values were not concerned with the pre-engineering fields but rather more related to the fields they joined or wanted to join. Participant FG4-Ele-M1 commented that, *"Bus grades ajana he hamaray lea maqsad hota hy qk understanding kon dekhta hy bus har jaga grades dekhy jaty hain samajh aye na aye bus ratta mara grade ly lia [Grades are the aim because who checks the understanding (who is interested in understanding of the student), grades are important for every one either you understand something or not, just cram and achieve grade]".*

Students of electronics were not satisfied with the educational system where burdening the students was facilitated and accepted whereas understanding of the material was not important for them. A participant FG3-Eng-M2 commented that, *"Parhai to wo hoti hay jo itmenan dy sakay k kuch knowledge gain kia hay baqi to marks waghera ka soch kar parhain to tension he hoti hay bus [The thing which satisfies you that you have gained some knowledge is actually studying, otherwise thinking about marks can only give you tension] ".*

Student from Electronics majorly reported their shortcomings which were the reason for their low achievement while the students from English and psychology were majorly happy with their academic achievements at pre-engineering level and reported a more organized way of studying. A student from English department FG2-Eng-M5 said, *"Ma apna sara material pehly achy ce arrange karta tha, apny class fellows ko parhata tha jis ce mera concept zeada clear ho jata revision bhi ho jati the. Marks mere bht achy aty thy [I used to arrange my study material properly, helped my class fellows in studies which helped me in getting more clarity of the topic and revision of the topic. My marks were always good"].*

Another student from psychology FG1-Psy-M1 reported, "*Teachers apny tareeqay ce parhaty hain unki arrangement mukhtalif hoti hay topic wise magr ma apny hisab ce topics ko arrange karta hun phir parhta hu, ya parhty parhty arrange karta jata hu k kon sa topic kahan ana chahea phir revise karta hun achy ce concept clear ho jata hy [Teachers have their own way of teaching and different arrangement of material topic wise but I used to arrange the topics in my way then study them or arrange the material while studying that where to place topics in the arrangement, then I revise its which helps in more concept clarity]".*

In summary engineering students were guided by extrinsic motivation, extrinsic values, extrinsic forces as compared to non-engineering students who wanted to contribute towards the welfare of the society and were working more for their internal satisfaction.

Conclusion

Both groups differed in their interest, motivation, support and barriers although students from non-engineering academic fields had high grades and a potential to continue engineering but the barriers caused a hindrance in pursuing the field along with a lack of

interest and motivation. Hence, the qualitative study highlighted the importance of the factors such as interest, motivation, self-efficacy, support, and barriers in pursuing the field of engineering.

Student's lack of interest in the fields of engineering and technology has rendered unanswerable question marks for the educationists, companies, and policy makers about the underlying psychosocial factors which need to be addressed by having an evidence-based approach.

Implications

This study may help in devising a protocol based on the identified factors that could be offered to schools and colleges for career counseling of their students either to pursue career in the field of engineering or not. The results will also help in policy formulation process as well as assist in need assessment of the students and teachers of pre-engineering studies to excel in engineering.

Career guidance is needed in all age groups whether you are a student, a job seeker, or an adult. Age appropriate evaluation of the students will help them in being more confident about their ability, interest, and efficacy to achieve their aspirations.

It may help the stakeholders and concerned to know the barriers and other factors that are causing hindrance in the way of academic achievement of the students who wants to pursue engineering. It may also make the concerned authority understand the importance of interest, motivation, self-efficacy, and support for selection and pursuing a subject to be successful in their respective fields.

It may open a window of opportunity for all stakeholders including students, teachers, parents, and educational institutions to negotiate the possible options based on student's ability, intellect, and motivation in context of barriers and social support system.

Limitations and suggestions

A major limitation of the present study is a lack of diversity in the sample, which hampers the generalizability of the research findings. Most of the sample was taken from the Universities of Rawalpindi, and Islamabad hence, a sample taken from other provinces and cities can contribute to overcoming this limitation. Proportionate sample of both genders could not be identified for the study and therefore it is recommended for future studies to have an equal representation of both genders.

References

Ahmed, T., Raza, S. H., Maryam, A., Setzer, W. N., Braidy, N., Nabavi, S. F., ... & Nabavi, S. M. (2016). Ginsenoside Rb1 as a neuroprotective agent: A review. *Brain Research Bulletin*, *125*, 30-43.

Ali, H. H., & Jameel, H. T. (2016). Causes of poor performance in mathematics from teachers, parents, and student's perspective. *American Scientific Research Journal for Engineering, Technology, & Sciences (ASRJETS)*, *15*(1), 122-136.

Ali, M. S., Iqbal, A., & Akhtar, M. M. S. (2013). Students' attitude towards science and its relationship with achievement score at intermediate level. *Journal of Elementary Education*, *25*(2), 61-72.

Anwar, T. (2017). *Design-based online teacher Kentprofessional development to introduce integration of STEM in Pakistan* (Doctoral dissertation, University of Minnesota). Proquest LLC.

Anwer, M., Iqbal, H. M., & Harrison, C. (2012). Students' attitude towards science: A case of Pakistan. *Pakistan Journal of Social & Clinical Psychology*, *9*(2), 3-9.

Baillie, C. & Fitzgerald, G. (2000) Motivation and attrition in engineering students. *European Journal of Engineering Education, 25*(2), 145-155. http://doi.10.1080/030437900308544

Bandura, A., & Adams, N. E. (1977). Analysis of self-efficacy theory of behavioral change. *Cognitive Therapy & Research*, *1*(4), 287-310.

Bandura, A., Barbaranelli, C., Caprara, G. V., & Pastorelli, C. (2001). Self-efficacy beliefs as shapers of children's aspirations and career trajectories. *Child Development*, *72*(1), 187-206.

Banning, J., & Folkestad, J. E. (2012). STEM education related dissertation abstracts: A bounded qualitative meta-study. *Journal of Science Education & Technology*, *21*(6), 730-741.

Beggs, J. M., Bantham, J. H., & Taylor, S. (2008). Distinguishing the factors influencing college students' choice of major. *College Student Journal*, *42*(2), 381-395.

Bergin, D. A. (2016). Social influences on interest. *Educational Psychologist*, *51*(1), 7-22.

Betz, N. E. (2007). Career self-efficacy: Exemplary recent research and emerging directions. *Journal of Career Assessment*, *15*(4), 403-422.

Birks, M., & Mills, J. (2011). Essentials of grounded theory. *Grounded theory: A practical guide*, 11-26.

Bøe, M. V., Henriksen, E. K., Lyons, T., & Schreiner, C. (2011). Participation in science and technology: young people's achievement-related choices in late-modern societies. *Studies in Science Education*, *47*(1), 37-72.

Boucher, K. L., Fuesting, M. A., Diekman, A. B., & Murphy, M. C. (2017). Can I work with and help others in this field? How communal goals influence interest and participation in STEM fields. *Frontiers in Psychology*, *8*, 901. https://doi.org/10.3389/fpsyg.2017.00901

Carlone, H. B., & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *44*(8), 1187-1218.

Carnevale, A. P., Smith, N., & Melton, M. (2011). *STEM: Science Technology Engineering Mathematics.* Georgetown University Center on Education & the Workforce. https://files.eric.ed.gov/fulltext/ED525297.pdf

Carr, P. B., & Walton, G. M. (2014). Cues of working together fuel intrinsic motivation. *Journal of Experimental Social Psychology*, *53*, 169-184.

Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2007). Teacher credentials and student achievement: Longitudinal analysis with student fixed effects. *Economics of Education Review*, *26*(6), 673-682.

Cochran, M., & Patton, M. Q. (2002). *A Guide to using qualitative research methodology.* London: Medecins Sans Frontieres.

Commission on Professionals in Science and Technology -CPST (2007, Oct 9). *Is US science and technology adrift?* STEM Workforce Data Project: Report No. 8. Washington, DC: CPST. https://www.nsf.gov/attachments/117803/public/Xb--Expanding_Underrepresented_Minority_Participation.pdf

Creed, P. A., Patton, W., & Prideaux, L. A. (2007). Predicting change over time in career planning and career exploration for high school students. *Journal of Adolescence*, *30*(3), 377-392.

Creswell, J. W., Hanson, W. E., Clark Plano, V. L., & Morales, A. (2007). Qualitative research designs: Selection and implementation. *The Counseling Psychologist*, *35*(2), 236-264.

Daugherty, J. L., Reese, G. C., & Merrill, C. (2010). Trajectories of mathematics and technology education pointing to engineering design. *Journal of Technology Studies*, *36*(1), 46-52.

Daugherty, J., Westrick, M., Zeng, Y., Merrill, C., & Custer, R. (2007). Delivering core engineering concepts to secondary level students using the STL. Paper presented at the meeting of the International Technology Education Association Conference, San Antonio, TX. https://digitalcommons.usu.edu/ncete_present/25/

DeMarie, D., & Aloise-Young, P. A. (2003). College students' interest in their major. *College Student Journal*, *37*(3), 462-470.

Donnelly, D. L., & Borland Jr, K. W. (2002). Undeclared students' patterns of declaration: Practical and political implications for orientation and transition programs. *Journal of College Orientation & Transition*, *10*(1), 5-13.

Dutta, A., Kang, H. J., Kaya, C., Benton, S. F., Sharp, S. E., Chan, F., ... & Kundu, M. (2015). Social-Cognitive Career Theory predictors of STEM career interests and goal persistence in minority college students with disabilities: A path analysis. *Journal of Vocational Rehabilitation*, *43*(2), 159-167.

Eccles, J. (2009). Who am I and what am I going to do with my life? Personal and collective identities as motivators of action. *Educational Psychologist*, *44*(2), 78-89.

Eccles, J. S., & Roeser, R. W. (2009). *Schools, academic motivation, and stage-environment fit.* In R. M. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology: Individual bases of adolescent development* (p. 404–434). John Wiley & Sons Inc. https://doi.org/10.1002/9780470479193.adlpsy001013

Ferry, T. R., Fouad, N. A., & Smith, P. L. (2000). The role of family context in a social cognitive model for career-related choice behavior: A math and science perspective. *Journal of Vocational Behavior*, *57*(3), 348-364.

Fouad, N. A., & Smith, P. L. (1996). A test of a social cognitive model for middle school students: Math and science. *Journal of Counseling Psychology*, *43*(3), 338.

Fouad, N. A., Guillen, A., Harris-Hodge, E., Henry, C., Novakovic, A., Terry, S., & Kantamneni, N. (2006). Need, awareness, and use of career services for college students. *Journal of Career Assessment*, *14*(4), 407-420.

Fuesting, M. A., & Diekman, A. B. (2017). Not by success alone: Role models provide pathways to communal opportunities in STEM. *Personality & Social Psychology Bulletin*, *43*(2), 163-176.

Gainor, K. A. (2006). Twenty-five years of self-efficacy in career assessment and practice. *Journal of Career Assessment*, *14*(1), 161-178.

Goulet, L. R., & Singh, P. (2002). Career commitment: A reexamination and an extension. *Journal of Vocational Behavior*, *61*(1), 73-91.

Hall, C., Dickerson, J., Batts, D., Kauffmann, P., & Bosse, M. (2011). are we missing opportunities to encourage interest in STEM fields? *Journal of Technology Education*, *23*(1), 32-46.

Harackiewicz, J. M., Rozek, C. S., Hulleman, C. S., & Hyde, J. S. (2012). Helping parents to motivate adolescents in mathematics and science: An experimental test of a utility-value intervention. *Psychological Science*, *23*(8), 899-906.

Hazari , J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education*, *25*(9), 1049-1079.

Hazari, Z., Sonnert, G., Sadler, P. M., & Shanahan, M. C. (2010). Connecting high school physics experiences, outcome expectations, physics identity, and physics career choice: A gender study. *Journal of Research in Science Teaching*, *47*(8), 978-1003.

Hodkinson, P. (2008). Grounded theory and inductive research. In N. Gilbert (Ed.), *Researching social life* (3rd ed.), pp. 81-100. London, UK: Sage.

Holmegaard, H. T., Madsen, L. M., & Ulriksen, L. (2014). To choose or not to choose science: Constructions of desirable identities among young people considering a STEM higher education programme. *International Journal of Science Education*, *36*(2), 186-215.

Hulleman, C. S., Kosovich, J. J., Barron, K. E., & Daniel, D. B. (2017). Making connections: Replicating and extending the utility value intervention in the classroom. *Journal of Educational Psychology*, *109*(3), 387. https://www.researchgate.net/publication/304778513_Making_Connections_Replicating_and_Extending_the_Utility_Value_Intervention_in_the_Classroom

Hulleman, C. S., Thoman, D. B., Dicke, A. L., & Harackiewicz, J. M. (2017). The promotion and development of interest: The importance of perceived values. In *The science of interest* (pp. 189-208). Springer, Cham.

Isaac, J. D., Sansone, C., & Smith, J. L. (1999). Other people as a source of interest in an activity. *Journal of Experimental Social Psychology*, *35*(3), 239-265.

Jack, G. U. (2013). The influence of identified student and school variables on students' science process skills acquisition. *Journal of Education & Practice*, *4*(5), 16-22.

Jackson, M. A., & Nutini, C. D. (2002). Hidden resources and barriers in career learning assessment with adolescents vulnerable to discrimination. *The Career Development Quarterly*, *51*(1), 56-77.

Jackson, M. C., Leal, C. C., Zambrano, J., & Thoman, D. B. (2019). Talking about science interests: the importance of social recognition when students talk about their interests in STEM. *Social Psychology of Education*, *22*(1), 149-167.

Jackson, S. (2004). *The quiet crisis: Falling short in producing American scientific and technical talent*. San Diego, CA: Building Engineering Science and Talent (BEST). http://www.bestworkforce.org/PDFdocs/Quiet_Crisis.pdf

Kekeya, J. (2016). Analysing qualitative data using an iterative process. *Contemporary PNG Studies*, *24*.https://202.165.203.251/en/images/All_Attachements/Research%20Journals/vol_24/2016-V24-7_Kekeya_analysing_qualitative_data.pdf

Kenny, M. E., Blustein, D. L., Chaves, A., Grossman, J. M., & Gallagher, L. A. (2003). The role of perceived barriers and relational support in the educational and vocational lives of urban high school students. *Journal of Counseling Psychology*, *50*(2), 142 – 155. https://doi.org/10.1037/0022-0167.50.2.142

Kong, F., Ding, K., & Zhao, J. (2015). The relationships among gratitude, self-esteem, social support, and life satisfaction among undergraduate students. *Journal of Happiness Studies*, *16*(2), 477-489.

Krapp, A. (2007). An educational–psychological conceptualisation of interest. *International Journal for Educational & Vocational Guidance*, *7*(1), 5-21.

Kuechler, W. L., McLeod, A., & Simkin, M. G. (2009). Why don't more students major in IS? *Decision Sciences Journal of Innovative Education*, *7*(2), 463-488.

Lam, P. C., Srivatsan, T., Doverspike, D., Vesalo, J., & Mawasha, P. R. (2005). A Ten-year assessment of the pre-engineering program for under-represented, low income and/or first-generation college students at The University of Akron. *Journal of STEM*

Education: Innovations & Research, *6*. https://www.jstem.org/jstem/index.php/JSTEM/article/view/1281

Lent, R. W. (2005). *A social cognitive view of career development and counseling*. In S. D. Brown & R. W. Lent (Eds.). Career development and counseling: Putting theory and research to work (pp. 101-127). New York: John Wiley

Lent, R. W., & Brown, S. D. (2006). On conceptualizing and assessing social cognitive constructs in career research: A measurement guide. *Journal of Career Assessment*, *14*(1), 12-35.

Lent, R. W., Brown, S. D., & Hackett, G. (2002). Social cognitive career theory. *Career Choice & Development*, *4*, 255-311.

Lincoln, Y. G., & Guba, E. (1985). E. 1985. *Naturalistic Inquiry*. London: Sage Publications.

Lowell, B. L., & Regets, M. C. (2006). *A half-century snapshot of the STEM workforce, 1950 to 2000*. Washington, DC: Commission on Professionals in Science and Technology.

MacGuire, S., & Halpin, G. (1995). *Factors related to persistence in engineering: Results of a qualitative study.* Paper presented at the Annual Meeting of the Mid-South Educational Research Association. https://files.eric.ed.gov/fulltext/ED398052.pdf

Malgwi, C. A., Howe, M. A., & Burnaby, P. A. (2005). Influences on students' choice of college major. *Journal of Education for Business*, *80*(5), 275-282.

Marginson, S., Tytler, R., Freeman, B., & Roberts, K. (2013). STEM: Country comparisons: International comparisons of science, technology, engineering, and mathematics (STEM) education. *Final Report*. Australian Council of Learned Academies, Melbourne, Vic. http://dro.deakin.edu.au/eserv/DU:30059041/tytler-stemcountry-2013.pdf

Master, A., Cheryan, S., Moscatelli, A., & Meltzoff, A. N. (2017). Programming experience promotes higher STEM motivation among first-grade girls. *Journal of Experimental Child Psychology*, *160*, 92-106.

Matthews, B., & Ross, L. (2014). *Research methods*. Pearson Higher Ed.

McInerney, D. M. (2008). Personal investment, culture and learning: Insights into school achievement across Anglo, Aboriginal, Asian and Lebanese students in Australia. *International Journal of Psychology*, *43*(5), 870-879.

McMullin, K., & Reeve, E. (2014). Identifying perceptions that contribute to the development of successful project lead the way pre-engineering programs in Utah. *Journal of Technology Education*, *26*(1), 22-46.

Memon, G. R., Joubish, M. F., & Khurram, M. A. (2010). Education in Pakistan: The key issues, problems and the new challenges. *Middle-East Journal of Scientific Research, 6*(6), 672-677.

Menéndez, M. D. C. R., Calvo, J. V. P., & Caro, M. D. L. M. I. (2016). " Esto es lo que me gusta y lo que voy a estudiar": Un estudio cualitativo sobre la toma de decisiones académicas en bachillerato 1/" This is what I like and what I am going to study": A qualitative study of academic decisions in high school. *Revista Complutense de Educación*, *27*(3), 1351.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: A sourcebook of new methods* (2nd ed.). Thousand Oaks, CA: Sage.

Mosley, P. H., Liu, Y., Hargrove, S. K., & Doswell, J. T. (2010). A pre-engineering program using robots to attract underrepresented high school and community college students. *Journal of STEM Education: Innovations & Research*, *11*(5). https://www.jstem.org/jstem/index.php/JSTEM/article/view/1281

Mousavi, S. E., Low, W. Y., & Hashim, A. H. (2016). Perceived parenting styles and cultural influences in adolescent's anxiety: A cross-cultural comparison. *Journal of Child & Family Studies*, *25*(7), 2102-2110.

Nathan, M. J., Atwood, A. K., Prevost, A., Phelps, L. A., & Tran, N. A. (2011). How professional development in project lead the way changes high school STEM teachers' beliefs about engineering education. *Journal of Pre-College Engineering Education Research, 1*(1), 15–29. http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1027&context=jpeer

Nauta, M. M., Kahn, J. H., Angell, J. W., & Cantarelli, E. A. (2002). Identifying the antecedent in the relation between career interests and self-efficacy: Is it one, the other, or both? *Journal of Counseling Psychology*, *49*(3), 290 – 301. https://doi.org/10.1037/0022-0167.49.3.290

Nieswandt, M. (2005). Attitudes toward science: A review of the field. In *Beyond Cartesian Dualism* (pp. 41-52). Springer, Dordrecht.

Nugent, G., Barker, B., Welch, G., Grandgenett, N., Wu, C., & Nelson, C. (2015). A model of factors contributing to STEM learning and career orientation. *International Journal of Science Education*, *37*(7), 1067-1088.

Ohland, M. W., Sheppard, S. D., Lichtenstein, G., Eris, O., Chachra, D., & Layton, R. A. (2008). Persistence, engagement, and migration in engineering programs. *Journal of Engineering Education*, *97*(3), 259-278.

Patton, M. Q. (2002). Two decades of developments in qualitative inquiry: A personal, experiential perspective. *Qualitative Social Work*, *1*(3), 261-283.

Renninger, K. A. (2009). Interest and identity development in instruction: An inductive model. *Educational Psychologist*, *44*(2), 105-118.

Renninger, K. A., & Bachrach, J. E. (2015). Studying triggers for interest and engagement using observational methods. *Educational Psychologist*, *50*(1), 58-69.

Renninger, K. A., & Hidi, S. (2016). Interest, attention, and curiosity. *The power of interest for motivation and engagement*, 32-51.

Renninger, K. A., & Riley, K. R. (2013). Interest, cognition and case of L-and science. *Cognition & Motivation: Forging an Interdisciplinary Perspective*, 352-382.

Richardson, M., Abraham, C., & Bond, R. (2012). Psychological correlates of university students' academic performance: A systematic review and meta-analysis. *Psychological Bulletin*, *138*(2), 353 -387. https://psycnet.apa.org/buy/2012-04281-001

Sagiv, L., & Schwartz, S. H. (2004). Values, intelligence, and client behavior in career counseling: A field study. *European Journal of Psychology of Education*, *19*(3), 237-254.

Salta, K., & Tzougraki, C. (2004). Attitudes toward chemistry among 11th grade students in high schools in Greece. *Science Education*, *88*(4), 535-547.

Sansone, C., & Thoman, D. B. (2005). Interest as the missing motivator in self-regulation. *European Psychologist*, *10*(3), 175-186.

Schunk, D. H., Pintrich, P. R., & Meece, J. L. (2008). *Motivation in education: Theory, research and applications* (3rd ed.). Upper Saddle River, NJ: Merrill-Prentice Hall.

Shoffner, M. F., Newsome, D., Barrio Minton, C. A., & Morris, C. A. W. (2015). A qualitative exploration of the STEM career-related outcome expectations of young adolescents. *Journal of Career Development*, *42*(2), 102-116.

Song, J., Bong, M., Lee, K., & Kim, S. I. (2015). Longitudinal investigation into the role of perceived social support in adolescents' academic motivation and achievement. *Journal of Educational Psychology*, *107*(3), 821 -841. http://doi:10.1037/edu0000016.

Swann Jr, W. B. (2011). Self-verification theory. *Handbook of theories of social psychology*, 23-42.

Tai, R. H., Liu, C. Q., Maltese, A. V., & Fan, X. (2006). Planning early for careers in science. *Science*, *312*(5777), 1143-1144.

Tan, L. M., & Laswad, F. (2009). Understanding students' choice of academic majors: A longitudinal analysis. *Accounting Education: An International Journal*, *18*(3), 233-253.

Thoman, D. B., Smith, J. L., & Silvia, P. J. (2011). The resource replenishment function of interest. *Social Psychological & Personality Science*, *2*(6), 592-599.

Tokar, D. M., Thompson, M. N., Plaufcan, M. R., & Williams, C. M. (2007). Precursors of learning experiences in social cognitive career theory. *Journal of Vocational Behavior*, *71*(3), 319-339.

Tracey, T. J., & Darcy, M. (2002). An idiothetic examination of vocational interests and their relation to career decidedness. *Journal of Counseling Psychology*, *49*(4), 420 – 427. https://doi.org/10.1037/0022-0167.49.4.420

United Nations Development Program (2013). Human Development Report 2013. The Rise of the South: Human Progress in a Diverse World. New York. http://hdr.undp.org/en/content/human-development-report-2013

Vedder-Weiss, D., & Fortus, D. (2012). Adolescents' declining motivation to learn science: A follow-up study. *Journal of Research in Science Teaching*, *49*(9), 1057-1095.

Wigfield, A., & Cambria, J. (2010). Achievement motivation. *The Corsini Encyclopedia of Psychology*, 1-2.